NASAfacts

Ares I–X Roll Control System (RoCS)

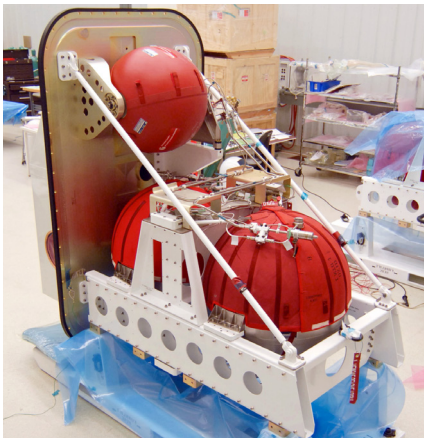

Image credit: Teledyne Brown Engineering

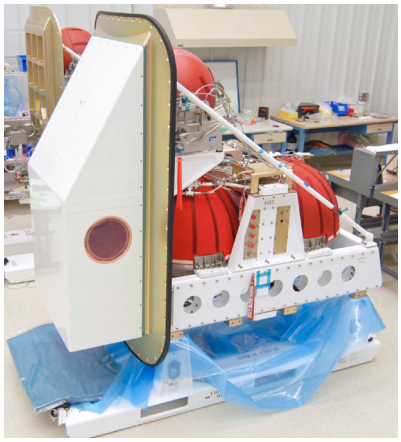

Image credit: Teledyne Brown Engineering

Overview

- Performs 90-degree roll maneuver after vehicle clears launch tower
- Controls roll attitude during flight
- Includes two modules with two engines each
- Integrated into the Upper Stage Simulator

Hardware

The Ares I-X Roll Control System (RoCS) was developed by Marshall Space Flight Center in Huntsville, Alabama, with Teledyne Brown Engineering as prime contractor. The RoCS performs two primary functions:

- Rolling the vehicle 90 degrees after liftoff to emulate the Ares I roll attitude at launch.
- Maintaining a constant roll attitude during ascent up to stage separation.

The RoCS, located in the lowest segment (the "inter-stage") of the Ares I-X Upper Stage Simulator (USS), consists of two modules, each containing two thrusters capable of generating up to 2250 pounds (10,000 newtons) of force (at vacuum). The RoCS modules, placed on opposite sides of the outer skin of the Upper Stage Simulator interstage, fire tangential to the skin and at right angles to the roll axis in order to provide a controlling roll torque.

The RoCS will operate from just after the rocket clears the tower until just before first stage separation. As part of the USS, the RoCS is expected to break up after it falls into the Atlantic Ocean and will not be recovered.

The RoCS propulsion system components were harvested from decommissioned Peacekeeper missiles, which were dismantled by the United States Air Force as part of the second Strategic Arms Reduction Treaty (START II). The use of Peacekeeper parts for RoCS (and Shuttle parts for the First Stage) was an effective means for NASA to reduce the cost and development time of this flight test, as the alternative would have been to design and build a new propulsion system or use and discard reaction control thrusters needed for the Space Shuttle.

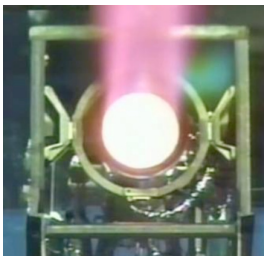

Image credit: NASA/WSTF

Hot Fire testing of the Ares I-X Roll Control System thrusters at White Sands Test Facility.

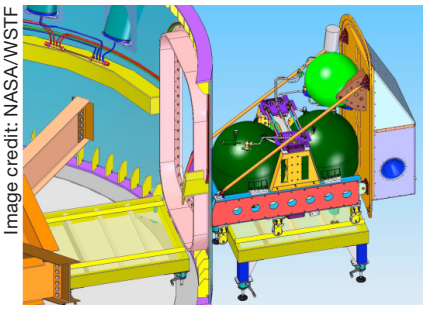

Image credit: Teledyne Brown Engineering

The Roll Control System modules were installed in the Upper Stage Simulator.

Image credit: Teledyne Brown Engineering

Technicians testing installation procedures for the Roll Control System using Roll Control System mass simulator.

Testing

The thrusters were hot-fire tested at White Sands Test Facility in 2007 and 2008 to verify that they could perform the pulsing duty cycle required by Ares I-X. The RoCS was tested successfully up to a half-second on, one-second-off cycle. The hot-fire tests also checked the RoCS for vulnerability to air-ingestion coming from the propellant lines, as will be the case during the initial roll maneuver pulse.

The RoCS was "cold-flow" tested at Teledyne Brown Engineering in Huntsville, Alabama prior to flight. During these tests, helium-pressurized water was passed through the tanks, pipes, and valves to check pressurization rates and pressure peaks during engine operation. Lastly, the RoCS modules were fit-tested for assembly and installation purposes after delivery to Kennedy Space Center (KSC) and before propellant loading. The fit check testing into the USS verified that the RoCS drill holes and panels matched the designated cutouts on the interstage segment and to provide installation procedure verification before installing the modules fully loaded with propellants.

Ground Operations

The propellants — nitrogen tetroxide (NTO) and monomethyl hydrazine (MMH) — were loaded into the modules at Kennedy Space Center's Hypergol Maintenance Facility (HMF). The modules were installed into the test vehicle in KSC's Vehicle Assembly Building (VAB) prior to rollout to Launch Complex 39B. Sharing the VAB and launch complex with the Space Shuttle program are other means by which to minimize mission costs.

Image Credit: NASA/KSC

Kennedy Space Center's Hypergol Maintenance Facility.

Element Team

The RoCS Integrated Product Team, attached to the Ares I-X Mission Management Office, is lead by the Science and Mission Systems Office at Marshall Space Flight Center.

National Aeronautics and Space Administration

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